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CLAIMS

[Claim(s)]
[Claim 1] Two or more hoop direction slots which were formed in the tire tread and arranged in the tire hoop direction, respectively, In the pneumatic tire for heavy loading which has the block pattern which divided into the block the land part divided at this hoop direction slot and the shoulder touch-down edge of tread tread section ends, and made it the block train by many transverse grooves the number of pitches of other block trains over the block train which has the minimum number A of pitches while the number of pitches of the block which constitutes each block train which adjoins mutually carries out difference mutually -- An -- [-- however, it is the value of 1.25-3.5 except the range of n (2**0.25).] It comes out, and it is and the product (c) of the depth (a) of the above-mentioned transverse groove and width of face (b) which divide each block train is in the number of pitches of a block train at reverse proportion relation. Furthermore, the ratio of the number of pitches to the block train which has this minimum number A of pitches is 3**0.5. The block train of the number of pitches in within the limits The pneumatic tire for low noise heavy loading characterized by arranging in at least one train of trains other than an outermost edge block train to the hoop direction center line of a tread, and no number ratios of pitches of each block train being mutually in agreement with the ratio of 1:2**0.25.
[Claim 2] It is the pneumatic tire for low noise heavy loading according to claim 1 which the block which constitutes each above-mentioned block train is ** pitch length, and is characterized by for the number of pitches of other block trains over the block train of the number of the minimum pitches to form two or more segments to which it is expressed with an easy integer ratio, and the combination die length of the number of two or more pitches of all block trains becomes equal, and for this number of segments to be within the limits of 8-12.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the pneumatic tire for heavy loading which carried out reduction amelioration of the noise generated from the tire of a transit car.
[0002]
[Description of the Prior Art] As a low noise-ized technique of this seed pneumatic tire, conventionally With the so-called variable pitch which the pitch length (the die length of a block) made arrange much several sorts of blocks which carry out difference on a tire periphery in suitable sequence on the periphery of the tread of a tire generally When a block hits a road surface, the attempt which used as the base the so-called variable pitch method for making the oscillation of many frequencies distribute the oscillation of the specific frequency decided and generated at the number and tire rotational frequency, and achieving lowering and low noise-ization for level is made.
[0003]
[Problem(s) to be Solved by the Invention] However, since this seed variable pitch method will have an adverse effect on the partial wear of a tread side, or oscillating generating if the large variable ratio of the minimum pitch length of the block for acquiring the dispersion effect of frequency energy in the pneumatic tire for heavy loading which are conditions absolutely - the maximum pitch length within the limits is take though that effectiveness is accept with a passenger car tire, this will be restrict. and the low noise-ized effectiveness compare with the rate of a cost rise of the mould for tire shaping accompanying enlarging the variable ratio of pitch length, and according to decentralization of a frequency -- so much -- being alike -- there is no profit. In order to surely form a transverse groove on the configuration especially in a block pattern The continuity of the touch-down at the time of tire rolling is lost, and, as a result, a tire hits a road surface. When it serves as exciting force, will appear, a tire will vibrate, the noise will be generated and it resonates with the frequency which is 500-800Hz whose frequencies of this exciting force are one of the tire resonant frequencies Another function to amplify an oscillation, i.e., the noise, is in a tire oscillation, and the dispersion effect of the frequency decided by the number of pitches and the engine speed has brought the result that the effectiveness does not almost exist, in few variable pitches.
[0004] Especially this artificer examined wholeheartedly functionality of the width of face of the number of pitches of each block, pitch length, and the slot that divides each block, the depth, and a distributed frequency in view of the actual condition like **** that it should study about the cause of a block pattern and noise generating as the above-mentioned tread pattern. consequently, the case where a vehicle is equipped with a tire -- as the effect of a block pattern -- a law, to the ** transit or coasting transit, it found out that the key factor of the tire noise was the oscillating sound of the number of repeats which is repeat pattern of a pattern, i.e., the frequency decided at the number of pitches and rolling rate of a block.
[0005] then, in order to cancel this, this artificer When in agreement with the natural frequency near 500-800Hz of the part near the touch-down which a tire has as this frequency, especially the level of the tire noise rises, furthermore, within the limits of 0 - 120 km/h as a rate region of

transit of a tire Resonating with said natural frequency and making the tire noise into size They are the primary frequency which is fundamental frequency, and the secondary frequency which is the harmonic content of the integral multiple, and from the point that generating of an oscillation stops being able to happen easily due to the periodic-damping engine performance of the rubber which constitutes a tire from harmonic content higher order than these, for example, the 3rd frequencies [4th], and the structural factor of a tire etc. While the excitation frequencies generated from each block train differed mutually, when the pitch was changed so that the double frequency might not be overlapped, either, it came to carry out the knowledge of the data of being effective.

[0006] Namely, this invention changes that number of pitches mutually for at least three sorts of two or more block trains that a primary frequency should be distributed in other frequencies. The frequency which generates the ratio to the number of the minimum pitches from each block train by considering as a specific scale factor, Namely, it is made to distribute without making it in agreement with the frequency (1st order) of the minimum pitch block train. Furthermore, the distributed frequency can keep noise level small at the time of resonance with the **** frequency of 500Hz - 800Hz of a tire by considering as the condition of not lapping with the harmonic content of said primary frequency, i.e., a secondary frequency.

[0007] While this invention was made based on the above-mentioned knowledge and changes the number of pitches of the block train of a tread pattern for every block train in this way as above-mentioned By considering as a pitch [length / of each block train / pitch] array, and considering specification of the number of pitches of each block train, and each block train as a specific array on the basis of the block which has the minimum number of pitches especially It sets it as the object to achieve reduction-izing of the noise at the time of transit of the pneumatic tire for heavy loading, and reduction-ization of the fabrication cost of the mould for tire shaping.

[0008]

[Means for Solving the Problem] The description of this invention that suits the above-mentioned object in this way Two or more hoop direction slots which were formed in the tire tread and arranged in the tire hoop direction, respectively, In the pneumatic tire for heavy loading which has the block pattern which divided into the block the land part divided at this hoop direction slot and the shoulder touch-down edge of tread tread section ends, and made it the block train by many transverse grooves the number of pitches of other block trains over the block train which has the minimum number A of pitches while the number of pitches of the block which constitutes each block train which adjoins mutually carries out difference mutually -- An -- [-- however, it is the value of 1.25-3.5 except the range of n (2**0.25).] It comes out, and it is and the product (c) of the depth (a) of the above-mentioned transverse groove and width of face (b) which divide each block train is in the number of pitches of a block train at reverse proportion relation. Furthermore, the ratio of the number of pitches to the block train which has this minimum number A of pitches is 3**0.5. The block train of the number of pitches in within the limits It is the configuration arranges in at least one train of trains other than an outermost edge block train to the hoop direction center line of a tread, and none of whose number ratios of pitches of each block train corresponds with the ratio of 1:2**0.25 mutually. And especially the block that constitutes each above-mentioned block train is ** pitch length, and the number of pitches of other block trains over the block train of the minimum number of pitches forms two or more segments to which it is expressed with an easy integer ratio, and the combination die length of the number of two or more pitches of all block trains becomes equal, and presupposes that this number of segments is within the limits of 8-12. In addition, in this invention, the rib type approximated to a block is also included in this.

[0009]

[Function] By the above mentioned outside block pattern of a tread Since it considered as the pitch [length / of each block train / pitch] array while changing the number of pitches of a block train for every block train The excitation frequency by the pitch generated from each block train carries out difference mutually, and it is 3**0.5 of the block train of the number of the minimum pitches especially. Twice, i.e., 2.5-3.5, By making a twice as many pitch sequence of

numbers as this mix A low noise-ized function is demonstrated without lapping with the primary order [2nd] of the frequency generated from other blocks. Furthermore, it is an integer ratio with the number of pitches of other block trains over the block train of the number of the minimum pitches all etc. are pitch length and easy in each block train. And so that the combination die length of the number of two or more pitches of all block trains may become equal Furthermore, the thing which it constitutes so that the number of segments for the tire 1 round may be set to 8-12, and the mold model at the time of a metal mold fabrication ends by one since it is moreover a ** pitch, Moreover, when it is difficult to remove a tire from metal mold at the time of tire shaping and it exceeds 12 pieces, the number of metal mold processings will increase, therefore it can contribute to reduction-ization of the fabrication cost of a tire mould by the less than number which is the practical number of segments, i.e., eight pieces.
[0010]
[Example] Although one example of the tire which starts this invention with reference to a drawing is hereafter explained to a detail, it cannot be overemphasized that this invention is not what is limited by these.
[0011] First, drawing 1 is drawing showing the tread pattern of the pneumatic tire 1 applied to this invention as one example, and since this tread 2 receives a big load in connection with the transit rolling motion of a tire, mutually, the block train 4 of five trains which consist of two or more blocks 3 mutually estranged along a tire hoop direction, respectively estranges crosswise [tire], and is arranged crosswise. And the block train 13 located on the hoop direction center line CL of a tread 2 is divided by two hoop direction slots 5 which estrange mutually and extend substantially crosswise [tire] in a tire hoop direction, and the transverse groove 6 which extends crosswise [tire] over those slots, and consists of two or more blocks 7 which are mutually estranged to a tire hoop direction and which carried out the square form mostly. Moreover, the block train 12 which adjoins the hoop direction center line CL of the tread of the block train 13 concerned outside pair Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne. at the way left-hand side shoulder touch-down edge S side is divided by the hoop direction slot 5 which adjoins the block train 13, other hoop direction slots 5 arranged in the tire cross direction outside, and two or more transverse grooves 8 which extend crosswise [tire], and consists of two or more blocks 10 of the rectangle mutually estranged to a tire hoop direction. The block train 14 which adjoins the way right-hand side shoulder touch-down edge S side outside the hoop direction center line CL of a tread to the block train 13 similarly consists of block 9 of the rectangle divided by two hoop direction slots 5 and two or more transverse grooves 16, and the so-called shoulder blocking trains 11 and 15 in the location which includes right-and-left both the shoulder touch-down edges S and S further consist of each block 18 and 19. And both the width of face of four hoop direction slots 5 and the depth are 13mm and 14mm. Moreover, it is more desirable to carry out pair dehiscence opening of the transverse grooves 6, 8, 16, and 17 to the hoop direction slot 5 or the shoulder touch-down edge S, to be in the free passage condition, and for ends to carry out opening, of course at relation, such as drainage.
[0012] by the way, the number of pitches of other block trains over the block train which it is making it change to two or more block trains [of a tread pattern], and number of pitches between each of that train specification-within the limits in this invention, and the inside of each block train is pitch length, such as all, and has the minimum number A of pitches -- 1.25A-3.5A -- [-- however, the range of 2**0.25 is removed. It is within the limits.
[0013] With the pattern shown in drawing 1 , the A= 60 minimum pitches and the number of the maximum pitches are these 3.0. It is one 1.75 times the 105 pitches of this, and 2.5 to 180 pitches and the meantime at twice. 150 twice as many pitches as this are mixed, respectively. namely, the shoulder blocking trains 11 and 15 -- the block train of number of minimum pitches 60 pitch -- it is -- the block train 12 -- 105 pitches and the block train 14 of 150 pitches and the block train 13 are [in the number of 2.5A pitches] the integer ratios of each 4:10:7 in 180 pitches in the number of 3A pitches at the number of 1.75A pitches. in addition, frequency f=NB (however, N is a rotational frequency for [tire] 1 second.) it is decided at the number of pitches which generates the reason except the range of n=(2**0.25) A with the number of pitches of B pieces, and a tire rotational frequency that the number of pitches will be is a primary frequency,

and the frequency of the integral multiple and harmonic content usually occur, and it can be expressed as fK =KNB (K= 1, and 2 and 3 -- it is ...). [however,] and -- among these, the case of K= 1 and K= 2 appears especially strongly, and is super-low level in K>=3. therefore, between the block train of the number B of pitches, and the block train of 2B, in accordance with the primary frequency of 2B, the secondary harmonic content of B laps and increases the level of a sound reversely in the case where n= 2 is adopted -- ******** -- n -- 2 -- **** -- it is because the same event occurs also in the case of near range of 2**0.25.

[0014] Furthermore, if it is in other examples of this invention, it makes with four block trains to the patterns of drawing 1 being five block trains, as shown in drawing 2 . That is, the block trains 22 which both the block trains 21 and 24 in the location which includes the outermost left and the right shoulder touch-down edges S and S of a tire to the hoop direction center line CL are block trains with the 60 minimum pitches, and are located between two block trains are 90 pitches (n= 1.5), and the block train 23 is what was made into the 150 (n= 2.5) maximum pitches, and they serve as an integer ratio of 4:6:10 respectively. Namely, with both the patterns shown in drawing 1 and drawing 2 , it is 1.25-3.5 of the number of the minimum pitches (n pitch). One pitch segment is constituted as the number of pitches of an integral multiple, and the range of 2**0.25 is removed. On the other hand, by this invention, the flute width (a) of a transverse groove and the product of a channel depth (b) (c), i.e., the cross section of a transverse groove, are important elements, and the cross section of each transverse groove shown in a table 1 has it in the number of pitches of each block train at the relation of reverse proportion also in the test result shown in a table 2. or this reason has the same cross section of a transverse groove -- or -- size -- sometimes The striking energy which a repeat pattern gives [as opposed to / as a result / a road surface] to the tire itself by the reason used as the thing proportional to the number of pitches naturally It is necessary not to desire lowering of sound pressure, though harmonic content acts advantageously to the attenuation nature of rubber how, therefore for a block train with many pitches to make smallness depth (a) x (width-of-face b) =c (cross section) of a transverse groove. moreover -- the need -- since it is divided into 8-12 isometric segments in order for the number of segments not to have the property needed for a tire in a tread shaping side, and a production process top trouble as a shaping mould of the pneumatic tire for heavy loading and to obtain a smooth function, it is optimal 8-12, and to make the number of segments especially 9-11. Generally, from the place where the mould for a tire fabrication is manufactured with the aluminium alloy casting, when there are many classes of segment, naturally model processing of the mold of varieties is needed. Then, if it is not adopted since there are many troubles on a production process when the number of segments is less than [above] eight, and 12 is exceeded, it is difficult in 1 segment in this invention to design under the block lengths [train / of two or more numbers of pitches / block], and since a mould increase in cost moreover becomes remarkable in the case of the different block length, it is not desirable. Therefore, a segment serves as here where it is limited to one kind with constituting the tread for tire 1 round from this invention, and cost lowering of a mould can be aimed at. In this case, the division location of a segment is selected by arbitration.

[0015] [-- an invention tire and the former -- comparison] of a tire -- the comparative study of a pattern noise with a tire 2 is explained a tire 1 and conventionally the invention tire 1 and the invention tire 2 which start this invention below, and conventionally.

[0016] A sample offering tire; ** tire size;11R 22.5 14 PR** rim size; 22.5x7.50 (tire pressure; 7.0kg/cm2, 2725kg of loads)

** Invention tire 1; it is the tire which has the tread pattern shown in drawing 1 .

** Invention tire 2; it is the tire which has the tread pattern shown in drawing 2 .

** Conventional tire 1; it is the tire which has the tread pattern shown in drawing 3 , and set the number of block pitches of each block train of 51, 52, 53, and 54 to 60.

** Conventional tire **; it is the tire which has the tread pattern shown in drawing 4 , and consider as 60 pitches (n) of the shoulder blocking trains 56 and 59 located in the outermost right-and-left shoulder touch-down edges S and S, and combine 120 (2n) pitches of the block trains 57 and 58 in the meantime.

[0017] In addition, although it bundled up about the flute width (a) of each transverse groove in

each tread pattern in above-mentioned drawing 1 - drawing 4 , a channel depth (b), and the cross-sectional area (c=axb) and was shown in a table 1, the cross-sectional area (c) serves as smallness like the block train with many pitches.
Following margin [0018]
[A table 1]

	横溝のサイズ				
ピッチ数 (n)	180 (3)	150 (2.5)	105 (1.75)	90 (1.5)	60 (1)
溝幅(a) (mm)	2	3	4	4.5	7
溝深さ(b) (mm)	10	10	12	12	14
断面積 (mm^2) (c= a×b)	20	30	48	54	98

[0019] B test-method; -- noise-test method; -- it carried out by the simple substance base top noise-test method according to JASO-C606.
[0020] The above-mentioned test result was shown in a table 2 about the functionality of the number of pitches about drawing 1 - drawing 4 , and the noise engine performance. However, about the noise engine performance, it indicated by the characteristic, having used the engine performance (O. A.L) in a tire 1 (drawing 3) as 100 conventionally (more nearly numerical smallness is good). Moreover, the result about each sound pressure level and noise level was shown in drawing 5 and drawing 6 , respectively. however, the sound pressure distribution [in / in drawing 5 / tire travel-speed (peripheral velocity) 80 km/h] for every frequency -- a table -- it is a thing the bottom, and drawing 6 gathers a rate for noise level every 10km in the range to the tire travel speed (peripheral velocity) 20 - 120 km/h, and shows the total noise level (O. A.L) for every rate. Following margin [0021]
[A table 2]

	本発明タイヤ								
	1 (図1)					2 (図2)			
ブロック列	11	12	13	14	15	21	22	23	24
ピッチ数	60	150	105	180	60	60	90	150	60
横溝断面積 (mm^2)	98	30	48	20	98	98	54	30	98
騒音性能	92					93			
	従来タイヤ								
	1 (図3)					2 (図4)			
ブロック列	51	52	53	54	56	57	58	59	
ピッチ数	60	60	60	60	60	120	120	60	
横溝断面積 (mm^2)	98	98	98	98	98	35	35	98	
騒音性能	100				98				

[0022] First, in drawing 5 , conventionally, with the tire 1 (drawing 3 R> 3), the number of pitches of a whole block train is set to 60, the exciting force of the same frequency is generated, 400Hz and the harmonic content of those of a primary peak are emphasized, and, on the whole, the whole block train serves as a high level. Moreover, conventionally, in the combination of the block train of 60 pitches of a tire 2 (drawing 4), and the block train of 120 of the number of double pitches, since the block train became a moiety, although the 1st order of 60 pitches is getting worse greatly, it turns out that the secondary peak and the primary peaks of the number

(120) of double pitches overlap, and near 800Hz is pushing up whole level extremely greatly. In this point, n is the reason which excepted the range of (2**0.25A) in this invention. Namely, with this invention tire (drawing 1), a block train with the 60 minimum pitches and the number of the maximum pitches are made one 3 times the number of 180 pitches of this. It is the block train of one 1.75 times the number of 105 pitches of this, and 2.5 to the meantime. The mixed array of the block train of the twice as many number of 150 pitches as this is carried out. Therefore, without the primary secondary peak of the frequency decided by the number of pitches of each block train lapping mutually, there is especially no conspicuous pitch peak, it distributes effectively, and the condition that level is low as a whole is maintained. Moreover, by considering as the 4 block train of 1 ******** from the case of the 5-block train of this invention tire 1 with this invention tire 2, it is the number of 60 pitches, the number of the maximum pitches is set to 150 2.5 times as many as this in the block train of the number of the minimum pitches, and it is further 1.5. Since the twice as many number of 90 pitches as this is arranged, distribution of a pitch peak be getting worse effectively, without the primary peak and secondary peak of each generating frequency lapping. On the other hand, in drawing 6 , reduction of noise level with large this inventions 1 and 2 is seen. Especially, it is the twice of the block train of the number of the minimum pitches (3-0.5), 2.5 [i.e.,]. Reduction-ization of the noise under tire transit is achieved by carrying out the mixed array of the block of the twice as many number of pitches as this, without lapping with the peak of the primary secondary frequency of the frequency generated from other blocks. Moreover, as the noise engine performance was also shown in a table 2 on the other hand, it turns out that this invention tires 1 and 2 are conventionally [both] excellent to tires 1 and 2.

[0023]

[Effect of the Invention] In this invention, in order to make the number of pitches of two or more block trains change mutually Since other frequencies are made to distribute a primary frequency by specifying the number ratio of pitches on the basis of the number of the minimum pitches, and the distributed frequency is distributed, without lapping also with the secondary frequency (harmonic content) of said frequency The noise and sound pressure level can be reduced as a whole, and, thereby, reduction-ization of the noise under tire transit can be achieved. Furthermore, the inside of each block train is ** pitch length, and since the number of pitches of other block trains over the block train of the number of the minimum pitches will constitute one pitch segment from an easy integer ratio and is limited to one kind, as a result, it can achieve reduction-ization of mould fabrication cost.

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TECHNICAL FIELD

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PRIOR ART

[Description of the Prior Art] As a low noise-ized technique of this seed pneumatic tire, conventionally With the so-called variable pitch which the pitch length (the die length of a block) made arrange much several sorts of blocks which carry out difference on a tire periphery in suitable sequence on the periphery of the tread of a tire generally When a block hits a road surface, the attempt which used as the base the so-called variable pitch method for making the oscillation of many frequencies distribute the oscillation of the specific frequency decided and generated at the number and tire rotational frequency, and achieving lowering and low noise-ization for level is made.

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EFFECT OF THE INVENTION

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, since this seed variable pitch method will have an adverse effect on the partial wear of a tread side, or oscillating generating if the large variable ratio of the minimum pitch length of the block for acquiring the dispersion effect of frequency energy in the pneumatic tire for heavy loading which are conditions absolutely - the maximum pitch length within the limits is take though that effectiveness is accept with a passenger car tire, this will be restrict. and the low noise-ized effectiveness compare with the rate of a cost rise of the mould for tire shaping accompanying enlarging the variable ratio of pitch length, and according to decentralization of a frequency -- so much -- being alike -- there is no profit. In order to surely form a transverse groove on the configuration especially in a block pattern The continuity of the touch-down at the time of tire rolling is lost, and, as a result, a tire hits a road surface. When it serves as exciting force, will appear, a tire will vibrate, the noise will be generated and it resonates with the frequency which is 500-800Hz whose frequencies of this exciting force are one of the tire resonant frequencies Another function to amplify an oscillation, i.e., the noise, is in a tire oscillation, and the dispersion effect of the frequency decided by the number of pitches and the engine speed has brought the result that the effectiveness does not almost exist, in few variable pitches.
[0004] Especially this artificer examined wholeheartedly functionality of the width of face of the number of pitches of each block, pitch length, and the slot that divides each block, the depth, and a distributed frequency in view of the actual condition like **** that it should study about the cause of a block pattern and noise generating as the above-mentioned tread pattern. consequently, the case where a vehicle is equipped with a tire -- as the effect of a block pattern -- a law, to the ** transit or coasting transit, it found out that the key factor of the tire noise was the oscillating sound of the number of repeats which is repeat pattern of a pattern, i.e., the frequency decided at the number of pitches and rolling rate of a block.
[0005] then, in order to cancel this, this artificer When in agreement with the natural frequency near 500-800Hz of the part near the touch-down which a tire has as this frequency, especially the level of the tire noise rises, furthermore, within the limits of 0 - 120 km/h as a rate region of transit of a tire Resonating with said natural frequency and making the tire noise into size They are the primary frequency which is fundamental frequency, and the secondary frequency which is the harmonic content of the integral multiple, and from the point that generating of an oscillation stops being able to happen easily due to the periodic-damping engine performance of the rubber which constitutes a tire from harmonic content higher order than these, for example, the 3rd frequencies [4th], and the structural factor of a tire etc. While the excitation frequencies generated from each block train differed mutually, when the pitch was changed so that the double frequency might not be overlapped, either, it came to carry out the knowledge of the data of being effective.
[0006] Namely, this invention changes that number of pitches mutually for at least three sorts of two or more block trains that a primary frequency should be distributed in other frequencies. The frequency which generates the ratio to the number of the minimum pitches from each block train by considering as a specific scale factor, Namely, it is made to distribute without making it in agreement with the frequency (1st order) of the minimum pitch block train. Furthermore, the

distributed frequency can keep noise level small at the time of resonance with the **** frequency of 500Hz - 800Hz of a tire by considering as the condition of not lapping with the harmonic content of said primary frequency, i.e., a secondary frequency.
[0007] While this invention was made based on the above-mentioned knowledge and changes the number of pitches of the block train of a tread pattern for every block train in this way as above-mentioned By considering as a pitch [length / of each block train / pitch] array, and considering specification of the number of pitches of each block train, and each block train as a specific array on the basis of the block which has the minimum number of pitches especially It sets it as the object to achieve reduction-izing of the noise at the time of transit of the pneumatic tire for heavy loading, and reduction-ization of the fabrication cost of the mould for tire shaping.

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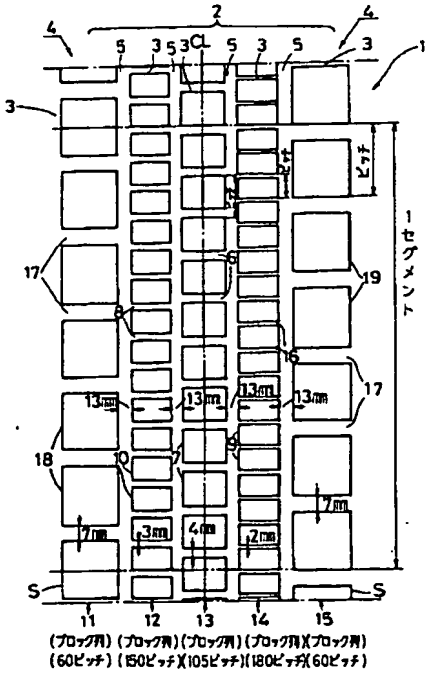
(54)【発明の名称】　低騒音重荷重用空気入りタイヤ

(57)【要約】

【目的】　重荷重用空気入りタイヤの走行時における騒音の低減化およびタイヤ成形用モールドの製作コストの節減化をはかる。

【構成】　トレッドパターンにおいて、相互に隣接する各ブロック列４，１１，１２，１３，１４，１５のブロック３，７，９，１０，１８，１９のピッチ数が相互に相異すると共に、最少のピッチ数Ａを有するブロック列に対する他のブロック列のピッチ数がＡｎ〔但し、ｎは（２±0.25）の範囲を除く1.25～3.5 の値である。〕であり、また、上記各ブロック列を区画する上記横溝６，８，１６，１７の深さ（ａ）と幅（ｂ）との積（ｃ）がブロック列のピッチ数に反比例関係にあり、更に、該最少のピッチ数Ａを有するブロック列に対するピッチ数の比が３±0.5 の範囲内にあるピッチのブロック列を周方向中心線に対し最外端ブロック列以外の列に配設する。



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【特許請求の範囲】

【請求項１】　タイヤトレッドに形成され、それぞれタイヤ周方向に配設された複数の周方向溝と、該周方向溝とトレッド踏面部両端のショルダー接地端とで区画される陸部を多数の横溝によってブロックに分割して、ブロック列としたブロックパターンを有する重荷重用空気入りタイヤにおいて、相互に隣接する各ブロック列を構成するブロックのピッチ数が、相互に相異すると共に、最少のピッチ数Ａを有するブロック列に対する他のブロック列のピッチ数がＡｎ〔但し、ｎは（２±0.25）の範囲を除く1.25～3.5 の値である。〕であり、各ブロック列を区画する上記横溝の深さ（ａ）と幅（ｂ）との積（ｃ）がブロック列のピッチ数に反比例関係にあり、更に、該最少のピッチ数Ａを有するブロック列に対するピッチ数の比が３±0.5 の範囲内にあるピッチ数のブロック列を、トレッドの周方向中心線に対し最外端ブロック列以外の列に少なくとも１列配設し、かつ、各ブロック列のすべてのピッチ数比が相互に１：２±0.25の比率と一致しないことを特徴とする低騒音重荷重用空気入りタイヤ。

【請求項２】　上記各ブロック列を構成するブロックは、等ピッチ長であって、最少ピッチ数のブロック列に対する他のブロック列のピッチ数は簡単なる整数比で表され、かつ、すべてのブロック列の複数ピッチ数の組合せ長さが等しくなるようなセグメントを複数個形成し、該セグメント数が８～１２の範囲内にあることを特徴とする請求項１記載の低騒音重荷重用空気入りタイヤ。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】この発明は、走行車両のタイヤから発生する騒音を低減改良させた重荷重用空気入りタイヤに関するものである。

【０００２】

【従来の技術】従来、この種空気入りタイヤの低騒音化技術としては、一般的にはタイヤのトレッドの周上にそのピッチ長（ブロックの長さ）が相異する数種のブロックを適当な順序で多数タイヤ周上に配列させたいわゆるバリアブルピッチにより、ブロックが路面を打撃する時、その個数とタイヤ回転数とで決められて発生する特定の周波数の振動を、多数の周波数の振動に分散させてレベルを下げ、低騒音化をはかる、いわゆるバリアブルピッチ法をベースとした試みがなされている。

【０００３】

【発明が解決しようとする課題】しかしながら、この種バリアブルピッチ法は、乗用車タイヤではその効果が認められるとしても、重荷重用空気入りタイヤにおいては周波数エネルギーの分散効果を得るための絶対条件であるブロックの最少ピッチ長～最大ピッチ長の範囲内におけるバリアブル比を大きくとるとトレッド面の偏摩耗や振動発生に悪影響を与えるので、これが制限されること

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となる。しかも、ピッチ長のバリアブル比を大きくすることに伴うタイヤ成形用モールドのコストアップの割合に比し、周波数の分散化による低騒音化効果はそれほどには得らない。特にブロックパターンにおいてはその構成上必ず横溝を形成するために、タイヤ転動時におけるその接地の連続性が失われ、その結果タイヤが路面を打撃し、それが加振力となって表れてタイヤが振動して騒音を発生することとなって、この加振力の周波数がタイヤ固有振動数の一つである５００～８００Hzの周波数と共振する時には、振動、即ち騒音を増幅するという別の機能がタイヤ振動にあり、ピッチ数と回転数で決まる周波数の分散効果が少ないバリアブルピッチではほとんどその効果がないという結果となっている。

【０００４】この発明者は、上述の如き実状に鑑み、上記トレッドパターンとして特にブロックパターンと騒音発生との原因について究明すべく、各ブロックのピッチ数、ピッチ長、および各ブロックを区画する溝の幅，深さと分散周波数との相関性について鋭意検討を行なった。その結果、タイヤを車に装着した場合ブロックパターンの影響として、定状走行あるいは惰行走行では、タイヤ騒音の主要因はパターンの繰り返し模様の繰り返し数、即ちブロックのピッチ数と転動速度とできまる周波数の振動音であることを見出した。

【０００５】そこでこの発明者は、これを解消するためには、この周波数としてタイヤのもつ接地近傍部分の５００～８００Hz付近の固有振動数に一致する時、特にタイヤ騒音のレベルがアップすること、更に、タイヤの走行の速度域としての０～１２０Km/hの範囲内では、前記固有振動と共振してタイヤ騒音を大とするのは、基本周波数である１次周波数とその整数倍の高調波成分である２次周波数であること、しかもこれらよりもより高次の高調波成分、例えば３次、４次等の周波数ではタイヤを構成するゴムの振動減衰性能およびタイヤの構造的要因により振動の発生が起こり難くなる点等から、各ブロック列から発生する加振周波数が相互に異なると共に、その倍の周波数とも重複しないようにピッチを変化させると効果があるという事実を知見するに至った。

【０００６】即ち、この発明は、１次周波数を他の周波数に分散すべく複数の少なくとも３種のブロック列を相互にそのピッチ数を変え、最少ピッチ数に対する比率を特定の倍率とすることで各ブロック列から発生する周波数、即ち最少ピッチブロック列の周波数（１次）に一致させずに分散させ、更にその分散周波数は前記１次周波数の高調波成分、即ち２次周波数にも重ならない状態とすることでタイヤの５００Hz～８００Hzの個有振動数との共振時に騒音レベルを小さく保つことができるものである。

【０００７】かくして、この発明は、上記知見に基づきなされたもので、上記のとおりトレッドパターンのブロック列のピッチ数を各ブロック列毎に変えると共に、各

ブロック列のピッチ長を等ピッチ配列とし、特に最少のピッチ数をもつブロックを基準として各ブロック列のピッチ数の特定化および各ブロック列を特定配列とすることにより、重荷重用空気入りタイヤの走行時における騒音の低減化およびタイヤ成形用モールドの製作コストの節減化をはかることをその目的とするものである。

【０００８】

【課題を解決するための手段】かくして、上記目的に適合するこの発明の特徴は、タイヤトレッドに形成され、それぞれタイヤ周方向に配設された複数の周方向溝と、該周方向溝とトレッド踏面部両端のショルダー接地端とで区画される陸部を多数の横溝によってブロックに分割して、ブロック列としたブロックパターンを有する重荷重用空気入りタイヤにおいて、相互に隣接する各ブロック列を構成するブロックのピッチ数が、相互に相異すると共に、最少のピッチ数Ａを有するブロック列に対する他のブロック列のピッチ数がＡｎ〔但し、ｎは（２±0.25）の範囲を除く1.25～3.5 の値である。〕であり、各ブロック列を区画する上記横溝の深さ（ａ）と幅（ｂ）との積（ｃ）がブロック列のピッチ数に反比例関係にあり、更に、該最少のピッチ数Ａを有するブロック列に対するピッチ数の比が３±0.5 の範囲内にあるピッチ数のブロック列を、トレッドの周方向中心線に対し最外端ブロック列以外の列に少なくとも１列配設し、かつ、各ブロック列のすべてのピッチ数比が相互に１：２±0.25の比率と一致しない構成である。そして、特に上記各ブロック列を構成するブロックは、等ピッチ長であって、最少のピッチ数のブロック列に対する他のブロック列のピッチ数は簡単なる整数比で表され、かつ、すべてのブロック列の複数ピッチ数の組合せ長さが等しくなるようなセグメントを複数個形成し、該セグメント数が８～１２の範囲内にあるとするものである。なお、この発明においては、ブロックに近似するリブタイプもこれに含まれるものである。

【０００９】

【作用】前記したトレッドの外面ブロックパターンでは、ブロック列のピッチ数をブロック列毎に変化させると共に、各ブロック列のピッチ長を等ピッチ配列としたので、各ブロック列から発生するピッチによる加振周波数が相互に相異し、特に最少ピッチ数のブロック列の３±0.5 倍即ち、2.5 ～3.5 倍のピッチ数列を混和させることにより、他のブロックから発生する周波数の１次、２次と重なることなく、低騒音化機能を発揮する。更に、各ブロック列内においては、すべて等ピッチ長であって最少ピッチ数のブロック列に対する他のブロック列のピッチ数は簡単な整数比であり、かつ、すべてのブロック列の複数ピッチ数の組合せ長さが等しくなるように、更にそのタイヤ１周分のセグメント数が８～１２となるように構成し、しかも等ピッチであるから金型製作時の鋳型モデルが一つですむこと、また実用的なセグメント数である数、即ち８個未満ではタイヤ成形時にタイヤを金型から取り外すことが困難であり、また１２個を越える時には金型加工数が増大することとなり、したがってタイヤモールドの製作コストの低減化に寄与することができる。

【００１０】

【実施例】以下、図面を参照してこの発明に係るタイヤの１実施例について詳細に説明するが、この発明はこれらによって限定されるものでないことはいうまでもない。

【００１１】先ず、図１は、１実施例としてこの発明に係る空気入りタイヤ１のトレッドパターンを示す図であり、該トレッド２はタイヤの走行転動に伴って大きな荷重を受けるのでそれぞれタイヤ周方向に沿って相互に離間する複数のブロック３よりなる５列のブロック列４が、タイヤ幅方向に相互に離間して配列される。そしてトレッド２の周方向中心線ＣＬ上に位置するブロック列１３は、タイヤ幅方向に相互に離間してタイヤ周方向に実質的に延在する２本の周方向溝５とそれらの溝間にわたってタイヤ幅方向に延在する横溝６とにより区画され、タイヤ周方向に相互に離間するほぼ平方形をした複数のブロック７よりなる。また、当該ブロック列１３のトレッドの周方向中心線ＣＬに対しその外方左側ショルダー接地端Ｓ側に隣り合うブロック列１２は、ブロック列１３に隣接する周方向溝５とそのタイヤ幅方向外側に配設される他の周方向溝５、およびタイヤ幅方向に延在する複数の横溝８により区画され、タイヤ周方向に相互に離間する長方形の複数のブロック１０よりなる。同様にブロック列１３に対しトレッドの周方向中心線ＣＬの外方右側ショルダー接地端Ｓ側に隣り合うブロック列１４は２本の周方向溝５と複数の横溝１６により区画される長方形のブロック９からなり、更に左右両ショルダー接地端Ｓ，Ｓを含む位置にある、いわゆるショルダーブロック列１１，１５は、それぞれのブロック１８，１９からなる。そして、４本の周方向溝５の幅，深さは共に１３mmと１４mmである。また横溝６，８，１６，１７は周方向溝５またはショルダー接地端Ｓに対し開口して連通状態となっており、もちろん両端が開口する方が水はけ等の関係で好ましい。

【００１２】ところで、この発明においては、トレッドパターンの複数のブロック列とその各列相互のピッチ数を特定範囲内に変化させることであり、各ブロック列内はすべて等ピッチ長であり、また最少のピッチ数Ａをもつブロック列に対する他のブロック列のピッチ数は、1.25Ａ～3.5 Ａ〔但し、２±0.25の範囲を除く。〕の範囲内である。

【００１３】図１に示すパターンでは、最少ピッチ数Ａ＝６０、最大ピッチ数はこれらの3.0 倍で１８０ピッチ、そしてその間に1.75倍の１０５ピッチ、2.5 倍の１５０ピッチをそれぞれ混成したものである。即ち、ショ

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ルダーブロック列１１，１５は最少ピッチ数６０ピッチのブロック列であり、ブロック列１２は2.５Ａピッチ数で１５０ピッチ、ブロック列１３は1.75Ａピッチ数で１０５ピッチ、そしてブロック列１４は３Ａピッチ数で１８０ピッチで各々４：１０：７の整数比である。なお、ピッチ数がｎ＝（２±0.25）Ａの範囲を除いた理由は、例えばＢ個のピッチ数によって発生するピッチ数とタイヤ回転数によって決まる周波数ｆ＝ＮＢ（但しＮはタイヤ１秒間の回転数である。）は１次周波数であり、通常その整数倍の周波数，高調波成分が発生し、ｆｋ＝ＫＮＢ（但しＫ＝１，２，３・・・である。）と表わせる。そしてこの内Ｋ＝１とＫ＝２の場合が特に強く表われ、Ｋ≧３では極低レベルである。従って、ｎ＝２を採用した場合ではピッチ数Ｂのブロック列と２Ｂのブロック列間では、Ｂの２次高調波成分は２Ｂの１次周波数と一致、重なって反対に音のレベルを増大させることになり、ｎが２に極く近い２±0.25の範囲の場合でも同様の事象が発生するからである。

【００１４】更に、この発明の他の実施例にあっては、図２に示した如く図１のパターンが５本のブロック列であるのに対し、４本のブロック列となしたものである。即ち、周方向中心線ＣＬに対しタイヤの最外側左・右ショルダー接地端Ｓ，Ｓを含む位置にあるブロック列２１，２４は共に最少ピッチ数６０のブロック列であり、２つのブロック列の間に位置するブロック列２２は９０ピッチ（ｎ＝1.５）であり、またブロック列２３は最大ピッチ数１５０（ｎ＝2.５）としたもので、各々４：６：１０の整数比となる。即ち、図１および図２に示したパターンでは共に最少ピッチ数（ｎピッチ）の1.25～3.５の整数倍のピッチ数として１つのピッチセグメントを構成し、２±0.25の範囲を除いてある。一方、横溝の溝幅（ａ）と溝深さ（ｂ）の積（ｃ）、即ち横溝の断面積もこの発明では重要な要素であって、表１に示した各横溝の断面積は表２に示した試験結果においても各ブロック列のピッチ数に反比例の関係にある。この理由は、横溝の断面積が同一かまたは大なる時には、繰り返し模様が路面に対して、ひいてはタイヤ自身に与える衝撃エネルギーは当然ピッチ数に比例したものとなる故に、いかに高調波成分がゴムの減衰性に対して有利に作用するとしても音圧の低下は望み得ず、したがって、ピッチ数の多いブロック列ほど横溝の深さ（ａ）×幅（ｂ）＝ｃ（断面積）を小とすることが必要となる。また必要なるセグメント数は重荷重用空気入りタイヤの成形モールドとしてトレッド成形面において、タイヤに必要とされる特性および製造工程上トラブルがなく円滑な機能を得るために８～１２個の等長のセグメントに分割されているために、セグメント数を８～１２、特に９～１１にすることが最適である。一般的に、タイヤ製作用モールドはアルミ合金鋳物で製作されているところから、セグメントの種類が多い時には当然多種類の鋳型のモデル加工が必要となる。そこで、セグメント数が上記の８未満の場合には生産工程上でトラブルが多いので採用されず、また１２を越えるとこの発明における１セグメント中に複数のピッチ数のブロック列を等ブロック長下で設計することは困難であり、しかも異ブロック長の場合にはモールドコストの増加が顕著となるので好ましくない。したがって、この発明ではタイヤ１周分のトレッドを構成することでセグメントは１種類に限定されることとなってモールドのコスト低下をはかることができる。この場合において、セグメントの分割位置は任意に選定される。

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【００１５】［発明タイヤと従来タイヤの対比］以下において、この発明に係る発明タイヤ１および発明タイヤ２と、従来タイヤ１および従来タイヤ２とのパターンノイズの比較試験について説明する。

【００１６】Ａ供試タイヤ；

① タイヤサイズ；１１Ｒ　22.5　１４　ＰＲ

② リムサイズ；　22.5×7.50

（タイヤ空気圧；7.0kg/cm²，荷重２７２５kg）

③ 発明タイヤ１；図１に示したトレッドパターンを有するタイヤである。

④ 発明タイヤ２；図２に示したトレッドパターンを有するタイヤである。

⑤ 従来タイヤ１；図３に示したトレッドパターンを有するタイヤであって、５１，５２，５３，５４の各ブロック列のブロックピッチ数を６０としたものである。

⑥ 従来タイヤ②；図４に示したトレッドパターンを有するタイヤであって、最外側の左右ショルダー接地端Ｓ，Ｓに位置するショルダーブロック列５６，５９のピッチ数６０（ｎ）とし、その間のブロック列５７，５８のピッチ数１２０（２ｎ）を組合せたものである。

【００１７】なお、上記図１～図４におけるそれぞれのトレッドパターンにおける各横溝の溝幅（ａ）、溝深さ（ｂ）、断面積（ｃ＝ａ×ｂ）については一括して表１に示したが、断面積（ｃ）はピッチ数の多いブロック列ほど小となっている。

以下余白

【００１８】

【表１】

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	横溝のサイズ				
ピッチ数（n）	180 (3)	150 (2.5)	105 (1.75)	90 (1.5)	60 (1)
溝幅(a)（mm）	2	3	4	4.5	7
溝深さ(b)（mm）	10	10	12	12	14
断面積（mm²）（c= a×b）	20	30	48	54	98

【００１９】B試験方法；
騒音試験法；ＪＡＳＯ－Ｃ６０６に準じた単体台上騒音試験法により行なった。

【００２０】上記試験結果は図１～図４についてのピッチ数と騒音性能との相関性について表２に示した。但し、騒音性能については従来タイヤ１（図３）における性能（Ｏ．Ａ．Ｌ）を１００として指数表示した（数値小程良好）。また、各音圧レベルおよび騒音レベルについ＊いての結果を図５および図６にそれぞれ示した。但し、図５は、タイヤ走行速度（周速度）８０Km/hにおける周波数毎の音圧分布を表したものであり、また図６は騒音レベルをタイヤ走行速度（周速度）２０～１２０Km/hまでの範囲で１０Km毎に速度をあげて各速度毎の全騒音レベル（Ｏ．Ａ．Ｌ）を示したものである。以下余白

【００２１】
【表２】

	本発明タイヤ								
	1（図1）					2（図2）			
ブロック列	11	12	13	14	15	21	22	23	24
ピッチ数	60	150	105	180	60	60	90	150	60
横溝断面積（mm²）	98	30	48	20	98	98	54	30	98
騒音性能	92					93			
	従来タイヤ								
	1（図3）				2（図4）				
ブロック列	51	52	53	54	56	57	58	59	
ピッチ数	60	60	60	60	60	120	120	60	
横溝断面積（mm²）	98	98	98	98	98	35	35	98	
騒音性能	100				98				

【００２２】まず、図５において、従来タイヤ１（図３）では全ブロック列のピッチ数を６０としたものであり、全ブロック列ともに同じ周波数の加振力を発生し、１次ピークの４００Hzとその高調波成分とが強調されて全体的に高レベルとなっている。また、従来タイヤ２（図４）の６０ピッチのブロック列と倍ピッチ数の１２０のブロック列の組合せでは、６０ピッチの１次はブロック列が半数となったために大きくレベルダウンしているもののその２次ピークと倍ピッチ数（１２０）の１次ピークとが重なり合って８００Hz付近が極端に大きく全体レベルを押上げていることが分かる。この点において、この発明ではｎは（２±0.25Ａ）の範囲を除外した所以である。即ち、本発明タイヤ（図１）では、最少ピッチ数６０のブロック列と最大ピッチ数を３倍の１８０ピッチ数とし、その間に1.75倍の１０５ピッチ数のブロック列と2.5 倍の１５０ピッチ数のブロック列を混合配列せしめたものであり、したがって各ブロック列のピッチ数できまる周波数の１次，２次ピークともに相互に重なることなく、特に目立ったピッチピークはなく、効果的に分散して全体としてレベルの低い状態が維持されている。また本発明タイヤ２では、本発明タイヤ１の５ブロック列の場合より１列減じて４ブロック列とし、そして最少ピッチ数のブロック列では６０ピッチ数であり、最大ピッチ数を2.5倍の１５０とし、更に1.5 倍の９０ピッチ数を配列しているのでピッチピークの分散は、各発生周波数の１次ピークと２次ピークが重なることなく効果的にレベルダウンしている。一方、図６では、本発明１，２共に大幅なる騒音レベルの低減がみられる。特に、最少ピッチ数のブロック列の（３－0.5)倍、即ち2.5 倍のピッチ数のブロックを混合配列せしめることによ

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り、他のブロックから発生する周波数の１次および２次周波数のピークと重なることなくタイヤ走行中における騒音の低減化がはかられる。また一方騒音性能についても表２に示した如く、本発明タイヤ１，２は、ともに従来タイヤ１，２に対しすぐれていることが分かる。

【００２３】

【発明の効果】この発明では、複数のブロック列のピッチ数を相互に変化せしめるために、最少ピッチ数を基準としてそのピッチ数比を特定することによって１次周波数を他周波数に分散せしめ、かつその分散周波数は前記周波数の２次周波数（高調波成分）にも重なることなく分散されるので、全体として騒音・音圧レベルを低下させ、それによりタイヤ走行中における騒音の低減化をはかることができる。更に、各ブロック列内は等ピッチ長であり、最少ピッチ数のブロック列に対する他のブロック列のピッチ数は、簡単なる整数比で１つのピッチセグメントを構成することとなって１種類に限定されるので、その結果モールド製作コストの節減化をはかることができる。

【図面の簡単な説明】

【図１】この発明の実施例の１例を示すその空気入りタイヤのトレッドパターンの概要平面図である。

【図２】この発明の他の実施例を示すその空気入りタイヤのトレッドパターンの概要平面図である。

【図３】従来タイヤの１例を示すその空気入りタイヤのトレッドパターンの概要平面図である。

【図４】従来タイヤの他の例を示すその空気入りタイヤのトレッドパターンの概要平面図である。

【図５】タイヤの周波数と音圧レベルとの関係グラフである。

【図６】タイヤの走行速度と騒音レベルとの関係グラフである。

【符号の説明】

１　空気入りタイヤ

２　トレッド

３，７，９，１０，１８，１９　ブロック

４，１１，１２，１３，１４，１５，２１，２２，２３，２４　ブロック列

５　周方向溝

６，８，１６，１７　横溝

ＣＬ　トレッドの周方向中心線

Ｓ　ショルダー接地端

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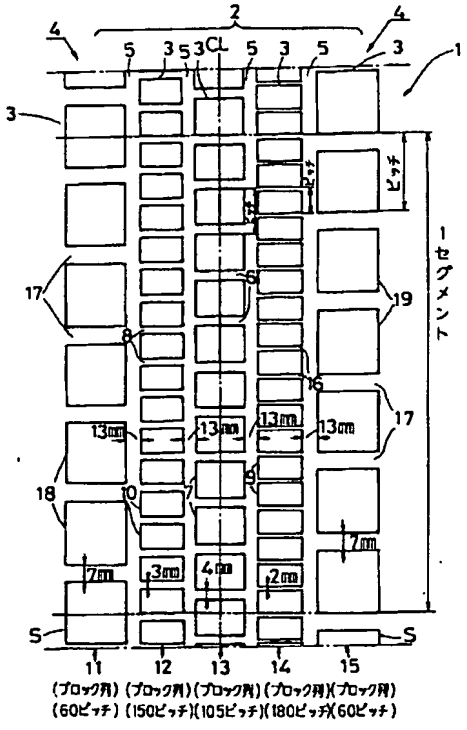
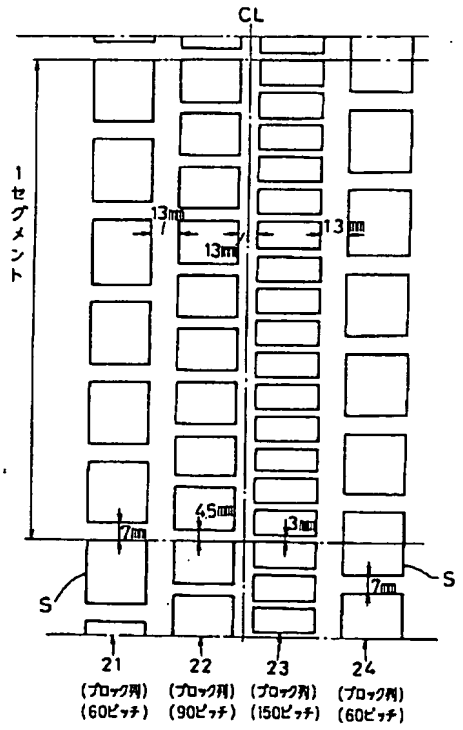
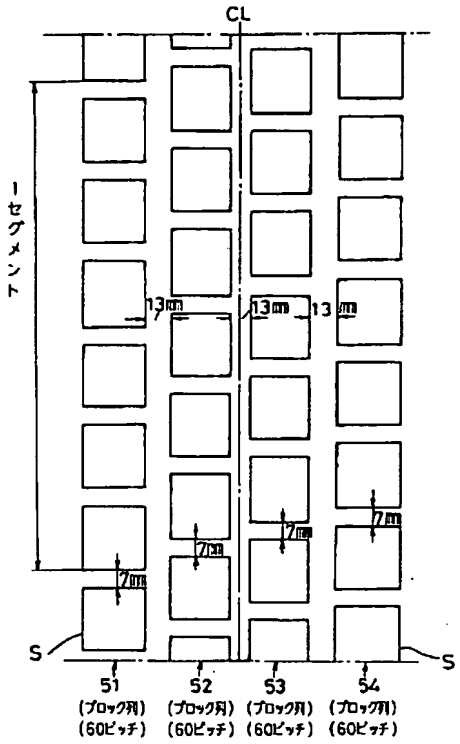
【図１】



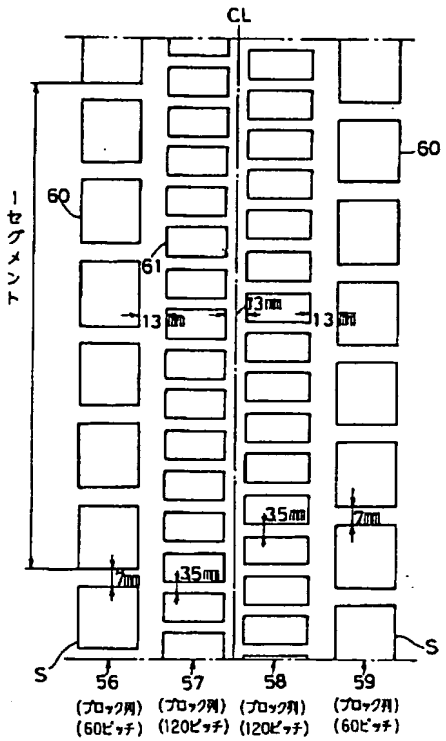
【図２】



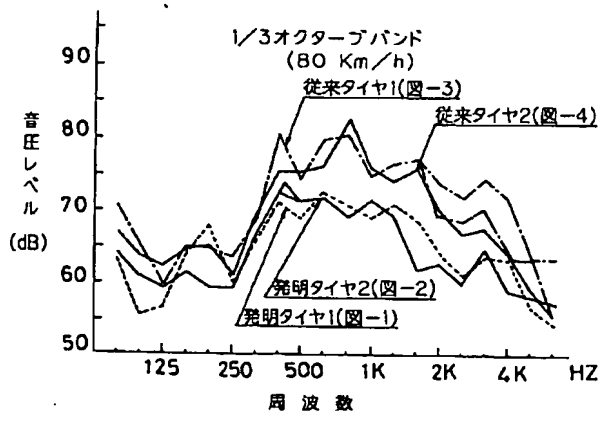
【図３】


CL
1セグメント
13mm
7mm
S
51
52
53
54
(ブロック列)
(60ピッチ)

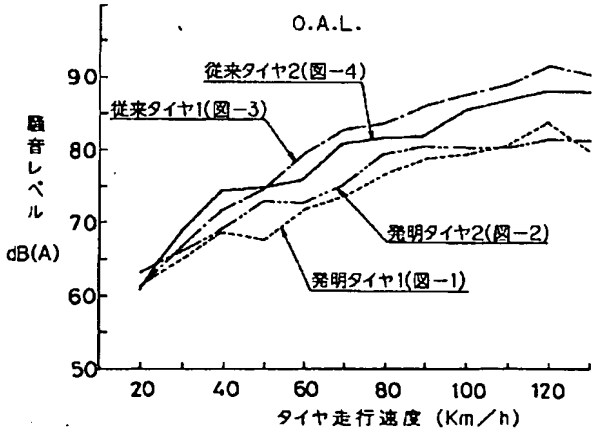
【図４】


CL
1セグメント
60
61
13mm
35mm
7mm
S
56
57
58
59
(ブロック列)
(60ピッチ)
(120ピッチ)

【図５】


1/3オクターブバンド
(80 Km/h)
従来タイヤ1(図−3)
従来タイヤ2(図−4)
発明タイヤ2(図−2)
発明タイヤ1(図−1)
音圧レベル
(dB)
90
80
70
60
50
125
250
500
1K
2K
4K
HZ
周波数

【図６】


O.A.L.
従来タイヤ2(図−4)
従来タイヤ1(図−3)
発明タイヤ2(図−2)
発明タイヤ1(図−1)
騒音レベル
dB(A)
90
80
70
60
50
20
40
60
80
100
120
タイヤ走行速度 (Km/h)